

PRELIMINARY DATA SUMMARY

September 1990

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

PRELIMINARY DATA SUMMARY

CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

CONTENTS

	<u>Page</u>
TABLE OF CONTENTS.....	1
PART I: INTRODUCTION.....	2
PART II: METEOROLOGICAL DATA.....	6
PART III: WAVE DATA.....	9
PART IV: CURRENT DATA.....	13
PART V: SUPPLEMENTAL OBSERVATIONS.....	20
PART VI: WATER LEVELS.....	22
PART VII: NEARSHORE PROFILES AND BATHYMETRY.....	25

LIST OF FIGURES

<u>No.</u>		<u>Page</u>
1	FRF location map.....	3
2	Instrument locations at FRF.....	5
3	Time history of wave heights and periods.....	12
4	Water level time history	23
5	CRAB profiles.....	25
6	CRAB profile envelope.....	26
7	FRF bathymetry (6 Sep 90).....	27

LIST OF TABLES

<u>No.</u>		<u>Page</u>
1	Instrument Status/Data Availability.....	4
2	Meteorological Data.....	7
3	Wave Data.....	10
4	Current Data.....	14
5	Supplemental Observations.....	21
6	Water Levels.....	24

PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

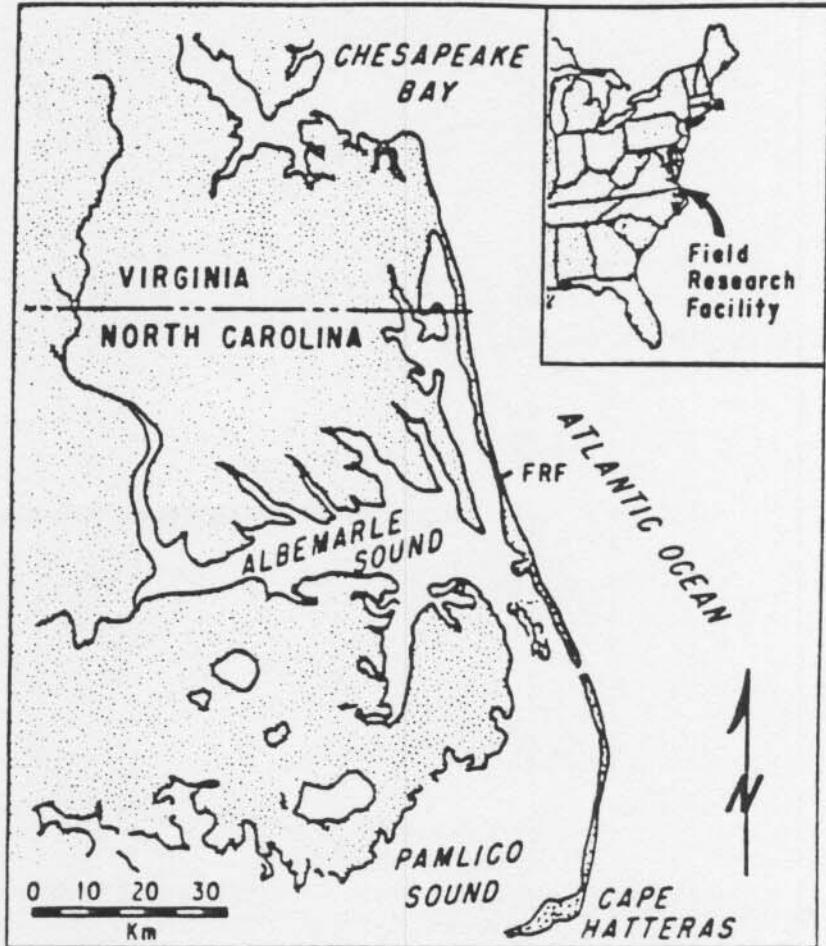


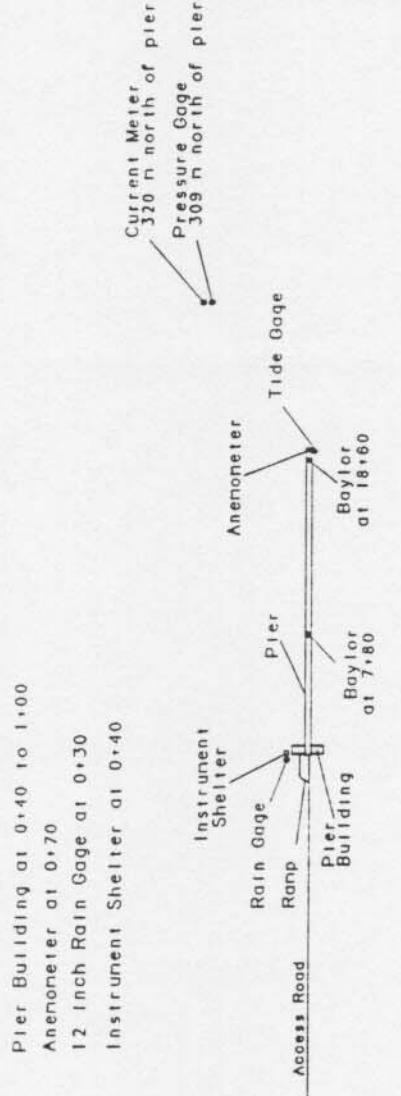
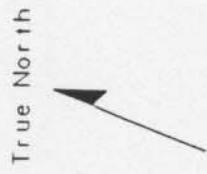
Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

SEP 1990

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																															
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0		
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
932	Anemometer at seaward end of pier Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	-	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	/				
			Data Collected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -



5

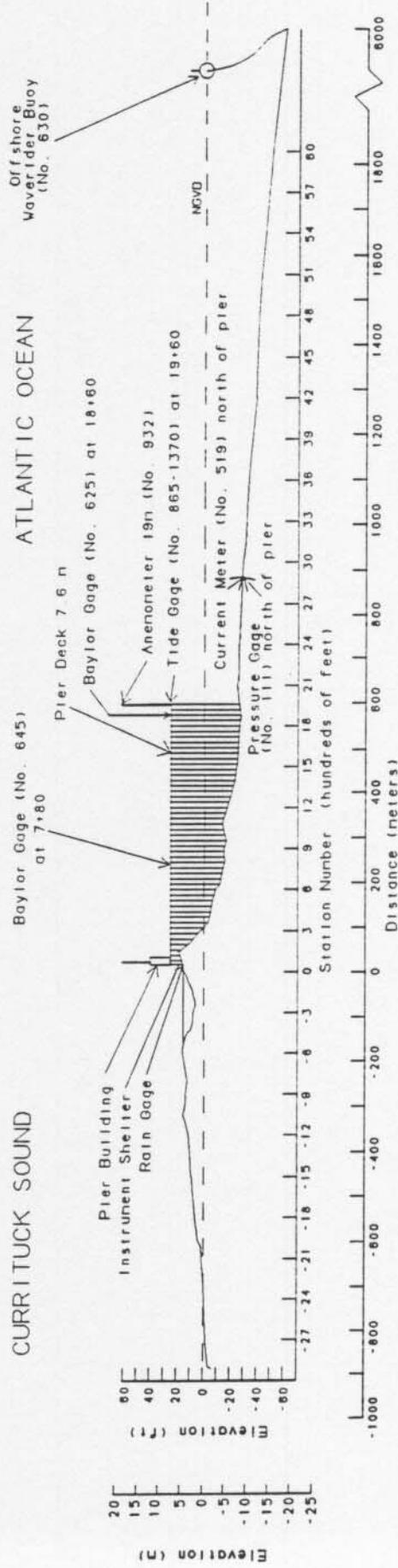


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Sep 1990

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	9	37	24.8	1017.5	0
	700	9	30	25.1	1018.9	0
	1300	6	33	25.6	1019.6	0
	1900	5	43	23.8	1018.9	0
2	100	2	13	21.8	1018.2	0
	700	2	313	23.1	1018.6	0
	1300	4	115	24.4	1017.2	0
	1900	6	182	25.3	1015.5	0
3	100	7	220	25.0	1015.5	0
	700	5	236	24.3	1015.9	0
	1300	7	19	25.8	1016.2	0
	1900	12	26	23.6	1018.6	0
4	100	10	43	23.3	1020.9	0
	700	10	21	23.0	1022.3	0
	1300	11	16	24.3	1023.0	0
	1900	8	24	22.3	1021.6	0
5	100	4	2	21.0	1020.6	0
	700	5	313	20.6	1019.9	0
	1300	5	19	24.0	1018.6	0
	1900	2	122	21.2	1016.2	0
6	100	4	178	20.8	1015.5	0
	700	4	236	22.8	1014.8	0
	1300	4	185	29.6	1013.1	0
	1900	7	180	25.5	1011.1	0
7	100	6	220	24.5	1011.1	0
	700	6	216	24.8	1010.8	0
	1300	6	200	30.3	1007.7	0
	1900	4	207	28.4	1008.1	0
8	100	9	298	23.8	1011.8	0
	700	7	11	24.7	1012.8	8
	1300	10	30	24.2	1016.2	0
	1900	9	60	23.1	1016.9	0
9	100	9	68	22.1	1017.9	0
	700	6	62	22.3	1018.2	0
	1300	3	54	25.1	1017.9	0
	1900	4	99	22.9	1016.2	0
10	100	4	150	23.6	1015.5	0
	700	5	217	24.8	1015.9	0
	1300	5	244	29.7	1015.2	0
	1900	6	36	25.2	1015.5	0
11	100	7	14	24.6	1016.2	0
	700	6	24	24.4	1018.2	0
	1300	6	25	25.8	1018.9	0
	1900	6	53	23.4	1018.6	0
12	100	4	48	22.9	1018.6	0
	700	6	37	23.7	1019.2	0
	1300	6	16	25.9	1018.9	0
	1900	6	36	24.4	1017.5	0
13	100	4	52	24.3	1017.9	0
	700	6	50	23.8	1017.9	0
	1300	5	48	25.7	1017.5	0
	1900	6	61	23.9	1016.5	0
14	100	5	47	24.1	1015.9	0
	700	1	38	23.7	1014.5	8
	1300	3	136	26.1	1012.1	0
	1900	5	168	23.4	1008.7	0
15	100	9	213	24.1	1006.4	0
	700	8	264	23.4	1005.0	0
	1300	6	232	28.0	1004.7	0
	1900	3	61	24.0	1005.4	0
16	100	3	164	22.1	1005.7	0
	700	1	192	24.3	1006.0	0
	1300	4	72	28.7	1004.7	0
	1900	3	38	24.5	1005.4	0

* electronic problems

(Continued)

Table 2: Meteorological Data

Sep 1990

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	13	335	19.8	1008.7	0
	700	11	324	17.2	1014.5	0
	1300	11	347	20.2	1017.2	0
	1900	8	325	17.9	1019.6	0
18	100	9	349	17.0	1022.3	0
	700	6	326	16.5	1023.3	0
	1300	4	352	18.6	1023.0	0
	1900	1	210	15.8	1021.6	0
19	100	1	187	16.3	1020.9	0
	700	3	205	19.6	1019.9	0
	1300	7	209	23.7	1017.2	0
	1900	7	186	22.0	1014.2	0
20	100	7	213	22.4	1012.8	0
	700	6	251	22.1	1013.5	0
	1300	6	359	25.1	1014.2	0
	1900	5	17	21.6	1015.9	0
21	100	7	20	21.6	1016.9	0
	700	6	54	21.2	1017.9	0
	1300	3	71	23.9	1017.2	0
	1900	6	80	20.8	1015.9	0
22	100	7	118	21.3	1013.5	0
	700	9	150	24.0	1009.8	0
	1300	6	207	25.9	1006.0	0
	1900	3	288	23.5	1004.0	0
23	100	8	335	22.0	1004.7	0
	700	6	6	21.3	1006.4	0
	1300	5	239	24.6	1005.4	0
	1900	10	310	19.7	1008.4	0
24	100	8	313	14.7	1012.1	0
	700	9	320	15.5	1015.5	0
	1300	5	350	19.0	1015.9	0
	1900	2	183	15.7	1015.9	0
25	100	3	173	14.9	1016.2	0
	700	3	204	16.6	1017.2	0
	1300	2	197	22.4	1015.9	0
	1900	8	181	19.3	1014.2	0
26	100	4	202	18.5	1013.5	0
	700	3	231	19.2	1012.8	0
	1300	6	191	24.5	1010.4	0
	1900	7	175	21.7	1009.8	0
27	100	4	308	17.9	1012.1	0
	700	6	315	17.7	1014.8	0
	1300	7	351	22.4	1015.9	0
	1900	6	18	20.5	1017.2	0
28	100	3	29	19.8	1017.9	0
	700	7	359	20.8	1019.6	0
	1300	4	19	22.4	1019.9	0
	1900	5	71	20.6	1019.2	0
29	100	3	23	20.4	1019.2	0
	700	4	63	21.4	1019.2	0
	1300	4	45	23.3	1018.9	0
	1900	6	58	21.9	1017.9	0
30	100	3	111	22.0	1017.2	0
	700	4	102	22.2	1016.2	0
	1300	3	221	24.1	1014.8	0
	1900	1	202	19.7	1013.8	5
		Resultant 2	Mean 16	Mean 22.5	Total 1015.1	21

* electronic problems

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Sep 1990

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo.m T.sec	Baylor at 18+60	Hmo.m T.sec	Pressure Gage	Hmo.m T.sec	Offshr Wvrdr	Hmo.m T.sec
1	0100	1.03	5.57	*		1.24	10.67	1.34	5.57
	0700	1.03	11.64	*		1.28	11.64	1.31	11.13
	1300	0.91	11.13	*		1.17	11.13	1.46	10.67
	1900	0.70	11.64	*		1.09	11.13	1.17	10.67
2	0100	0.73	12.19	*		1.05	9.85	1.01	12.80
	0700	0.54	11.64	*		0.85	10.67	0.89	11.13
	1300	0.60	16.00	*		0.86	16.00	0.93	16.00
	1900	0.55	14.22	1.01	14.22	0.93	14.22	0.88	14.22
3	0100	0.49	12.80	0.79	12.80	0.81	12.80	0.78	12.80
	0700	0.38	11.64	0.58	12.19	0.67	10.67	0.72	11.64
	1300	0.56	11.64	0.70	10.67	0.65	10.67	0.68	10.67
	1900	1.41	5.45	1.41	5.12	1.44	5.22	1.48	5.02
4	0100	1.72	6.40	1.74	6.40	2.07	6.24	1.95	6.56
	0700	1.46	6.74	1.63	6.92	1.68	11.64	1.64	6.92
	1300	1.64	8.26	1.75	8.53	1.86	5.22	1.81	5.45
	1900	1.48	9.14	1.67	7.76	1.81	8.53	1.91	8.26
5	0100	1.37	8.83	1.45	11.13	1.57	9.14	1.55	9.48
	0700	1.13	9.85	1.42	9.48	1.52	10.67	1.46	9.85
	1300	1.06	9.85	1.32	9.48	1.38	11.13	1.29	8.26
	1900	0.83	8.26	1.05	9.48	1.15	8.53	1.25	8.53
6	0100	0.65	10.67	0.87	9.85	1.02	9.48	1.07	9.48
	0700	0.44	9.48	0.70	8.83	0.84	8.26	0.95	8.83
	1300	0.38	9.48	0.65	9.48	0.74	8.83	0.73	9.14
	1900	0.38	8.53	0.58	8.83	0.58	8.83	0.75	8.53
7	0100	0.27	8.26	0.44	8.26	0.53	8.53	0.58	8.83
	0700	0.27	8.53	0.44	8.53	0.50	8.53	0.63	8.00
	1300	0.30	8.00	0.43	9.14	0.44	8.83	0.51	8.53
	1900	0.27	8.00	0.41	7.53	0.43	7.76	0.50	8.53
8	0100	0.30	8.00	0.47	8.00	0.49	8.53	0.61	7.53
	0700	0.50	3.51	0.68	3.24	0.50	3.51	0.69	3.51
	1300	1.32	5.22	1.19	5.12	1.26	5.45	1.35	5.22
	1900	1.65	7.53	1.61	7.53	1.66	7.53	1.73	6.92
9	0100	1.49	8.26	1.61	8.53	1.86	8.53	1.77	5.57
	0700	1.17	6.40	1.33	8.53	1.50	8.83	1.48	8.00
	1300	0.94	8.83	1.15	8.83	1.17	8.83	1.36	9.14
	1900	0.77	7.31	1.02	7.76	1.04	9.48	1.24	8.53
10	0100	0.63	7.53	0.87	9.48	0.82	8.26	0.87	8.26
	0700	0.48	8.26	0.91	8.83	0.86	8.53	0.85	8.83
	1300	0.44	8.53	0.74	7.76	0.94	9.14	0.89	9.14
	1900	0.65	8.83	0.80	8.26	0.74	8.53	0.71	8.83
11	0100	0.42	9.14	0.66	8.00	0.63	9.48	0.71	8.83
	0700	0.66	3.41	0.83	8.00	0.74	8.26	0.80	8.83
	1300	0.60	15.06	0.76	8.26	0.76	3.66	0.84	7.76
	1900	0.75	14.22	0.82	14.22	0.79	14.22	0.84	14.22
12	0100	0.66	14.22	0.98	14.22	0.89	14.22	0.94	14.22
	0700	0.73	15.06	0.87	12.80	0.86	14.22	0.94	14.22
	1300	0.64	13.47	0.93	13.47	1.07	13.47	1.05	14.22
	1900	0.81	12.80	1.01	12.80	0.99	12.80	1.07	12.80
13	0100	0.61	11.64	0.89	12.80	0.97	12.19	1.01	12.80
	0700	0.78	12.80	0.86	12.80	0.92	12.19	0.94	12.19
	1300	0.56	12.19	0.83	12.19	0.96	12.19	0.88	12.19
	1900	0.81	11.64	1.00	12.19	1.04	12.80	0.94	13.47
14	0100	0.84	14.22	1.09	12.19	0.98	11.13	1.01	11.64
	0700	0.86	13.47	1.12	12.19	1.17	12.80	1.03	13.47
	1300	0.68	12.80	1.10	12.80	1.07	11.64	1.10	12.80
	1900	0.67	12.19	0.90	12.80	0.89	13.47	0.86	12.80
15	0100	0.63	12.80	0.81	12.80	0.93	12.80	0.96	9.85
	0700	0.61	12.80	0.81	12.80	0.81	11.64	0.91	12.19
	1300	0.44	12.19	0.72	12.19	0.81	12.19	0.83	12.19
	1900	0.52	12.19	0.71	10.67	0.74	12.80	0.79	12.19
16	0100	0.55	13.47	0.70	11.64	0.75	12.80	0.74	12.80
	0700	0.45	12.19	0.65	11.64	0.60	11.64	0.68	12.19
	1300	0.59	11.13	0.72	11.13	0.87	11.64	0.75	11.64
	1900	0.49	11.13	0.65	11.64	0.70	12.19	0.72	11.13

* Electronic problems

(Continued)

(Sheet 1 of 2)

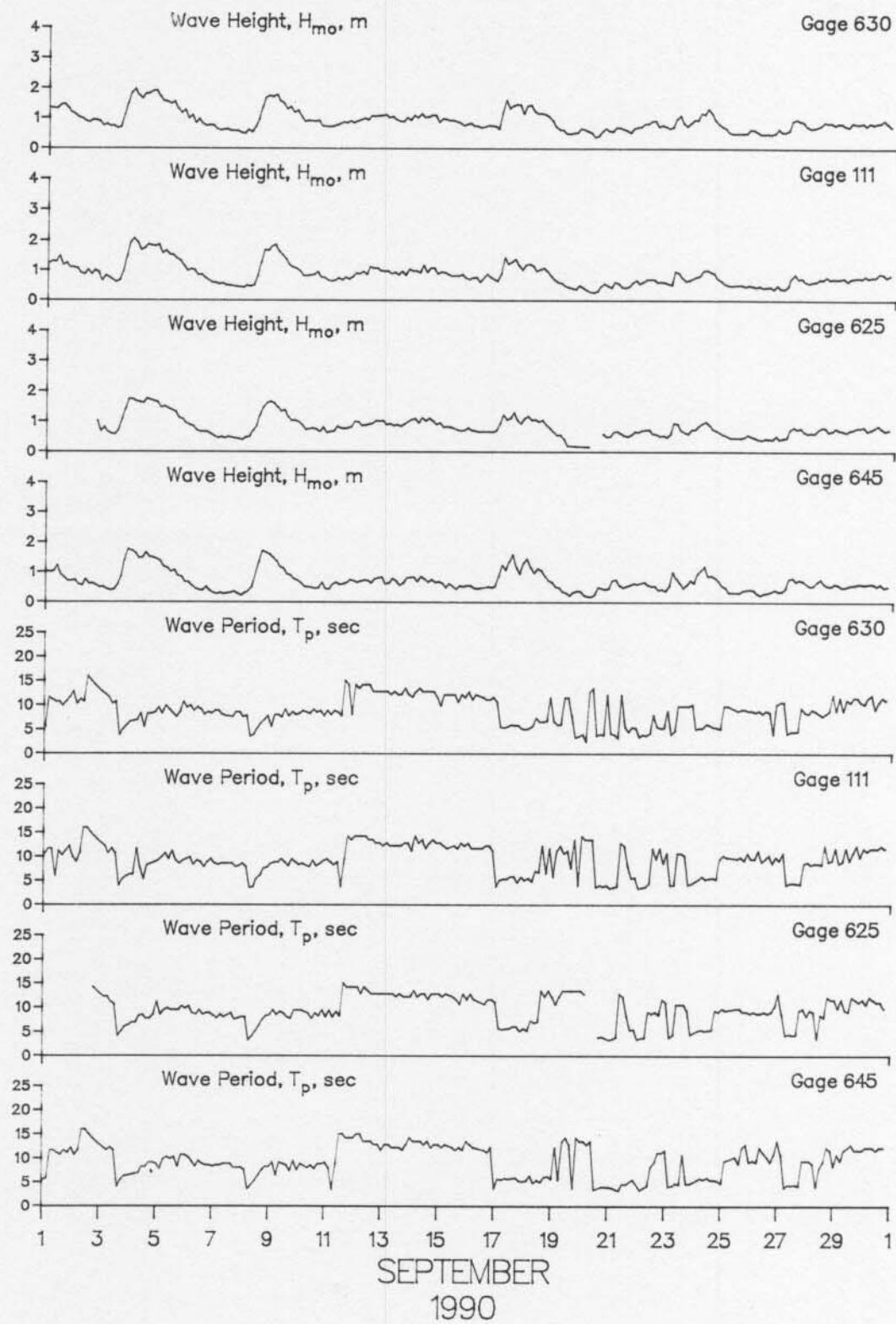
Table 3: Wave Data

Sep 1990

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo.m T.sec	Baylor at 18+60	Hmo.m T.sec	Pressure Gage	Hmo.m T.sec	Offshr Wvrdr	Hmo.m T.sec
17	0100	0.86	3.61	0.90	11.13	0.87	3.71	1.17	10.67
	0700	1.09	5.57	1.06	5.45	1.22	5.33	1.32	5.33
	1300	1.59	5.69	1.30	5.69	1.37	5.82	1.45	5.95
	1900	0.95	5.95	0.93	6.09	1.02	4.57	1.13	5.82
18	0100	1.44	5.12	1.17	5.69	1.21	5.12	1.43	4.92
	0700	0.98	6.40	1.05	7.31	0.97	4.83	1.14	5.69
	1300	1.06	5.45	1.03	7.11	1.07	6.74	1.11	6.56
	1900	0.72	6.09	0.78	12.19	0.80	6.40	0.92	6.74
19	0100	0.51	5.69	0.55	12.19	0.59	5.69	0.62	6.56
	0700	0.35	5.45	0.42	12.19	0.47	12.19	0.49	5.95
	1300	0.22	14.22	0.19	12.80	0.39	11.13	0.51	11.64
	1900	0.38	3.66	0.16	13.47	0.49	13.47	0.65	3.28
20	0100	0.23	13.47	0.16	13.47	0.34	14.22	0.57	4.00
	0700	0.18	12.80	0.13	12.80	0.25	13.47	0.37	12.80
	1300	0.50	3.41	0.15	12.80	0.47	3.61	0.57	3.66
	1900	0.43	4.00	0.50	4.00	0.49	3.77	0.57	3.82
21	0100	0.74	3.94	0.65	3.37	0.61	3.37	0.70	4.13
	0700	0.56	3.51	0.61	3.88	0.44	3.82	0.64	3.16
	1300	0.54	4.66	0.51	12.19	0.47	12.19	0.52	5.45
	1900	0.64	5.12	0.67	5.33	0.67	5.45	0.71	5.45
22	0100	0.65	3.61	0.71	3.41	0.62	3.37	0.82	3.41
	0700	0.57	3.82	0.74	3.71	0.70	3.71	0.90	3.71
	1300	0.53	8.26	0.58	8.83	0.61	11.64	0.73	8.00
	1900	0.43	11.13	0.53	8.53	0.60	11.64	0.72	5.22
23	0100	0.54	11.64	0.58	11.13	0.51	10.67	0.70	8.83
	0700	0.79	4.27	0.92	4.34	0.91	4.06	1.08	4.66
	1300	0.48	4.57	0.63	10.67	0.64	10.67	0.74	9.85
	1900	0.73	4.66	0.73	9.48	0.73	4.06	0.94	9.85
24	0100	0.96	5.02	0.86	4.83	0.83	4.83	1.16	5.02
	0700	1.19	5.82	1.00	5.45	1.02	5.82	1.30	5.33
	1300	0.88	5.95	0.75	5.33	0.90	5.45	0.92	5.82
	1900	0.71	5.45	0.63	9.48	0.64	5.22	0.71	5.33
25	0100	0.49	4.74	0.52	9.85	0.50	10.24	0.53	9.85
	0700	0.34	10.24	0.45	10.24	0.43	8.83	0.48	8.83
	1300	0.31	10.24	0.45	9.85	0.51	9.48	0.49	8.83
	1900	0.41	12.19	0.56	9.14	0.50	9.14	0.63	9.14
26	0100	0.41	9.14	0.45	8.83	0.44	9.48	0.55	8.83
	0700	0.24	9.14	0.38	8.83	0.41	11.13	0.47	8.83
	1300	0.31	11.13	0.42	9.14	0.44	9.48	0.46	8.83
	1900	0.42	9.14	0.52	9.14	0.49	8.53	0.64	3.94
27	0100	0.36	13.47	0.44	12.80	0.38	9.14	0.54	10.67
	0700	0.79	3.82	0.74	4.27	0.75	4.06	0.92	4.06
	1300	0.70	4.34	0.75	4.34	0.71	4.49	0.91	4.49
	1900	0.71	4.20	0.66	9.48	0.62	4.20	0.73	9.48
28	0100	0.53	9.48	0.62	8.26	0.62	8.83	0.67	8.26
	0700	0.68	8.83	0.73	9.14	0.71	8.53	0.77	8.83
	1300	0.63	8.00	0.80	8.53	0.79	8.26	0.85	7.76
	1900	0.53	12.19	0.69	12.19	0.72	8.83	0.79	8.83
29	0100	0.59	8.26	0.71	11.64	0.72	11.64	0.83	8.83
	0700	0.50	9.48	0.64	11.64	0.64	8.83	0.71	8.83
	1300	0.58	12.19	0.74	9.14	0.74	9.14	0.83	10.67
	1900	0.62	11.64	0.80	11.64	0.74	12.19	0.85	11.64
30	0100	0.60	11.64	0.69	11.64	0.75	11.64	0.85	10.24
	0700	0.62	12.19	0.80	12.19	0.79	11.64	0.84	12.19
	1300	0.61	11.64	0.77	11.13	0.88	11.64	0.94	10.67
	1900	0.52	12.19	0.72	9.85	0.83	11.64	0.72	11.13
Mean		0.69	9.05	0.80	9.47	0.85	9.20	0.92	8.80
Std dev		0.34	3.38	0.33	2.85	0.35	3.14	0.33	3.04

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Sep 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements				Current Meter		
		Dye at (579 m) (surface)	Speed	Dir	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)	Speed	Dir	(500m Updrift) Dye 12m offshore (surface)	Location	Speed	Dir
1 0100	Along Cross Result											
1 0700	Along Cross Result	15 8 17	S on 187		165	12 29 31	N on 272		South	12	N	
1 1300	Along Cross Result											
1 1900	Along Cross Result											
2 0100	Along Cross Result											
2 0700	Along Cross Result	5 4 6	N on 303		152	29 29 41	N on 295		South	16	N	
2 1300	Along Cross Result											
2 1900	Along Cross Result											
3 0100	Along Cross Result											
3 0700	Along Cross Result	21 0 21	N 340		140	44 0 44	N 340		South	36	N	
3 1300	Along Cross Result											
3 1900	Along Cross Result											
4 0100	Along Cross Result											
4 0700	Along Cross Result	34 8 35	S on 174		152	68 17 70	S on 174		North	65	S	
4 1300	Along Cross Result											
4 1900	Along Cross Result											
5 0100	Along Cross Result											
5 0700	Along Cross Result	38 0 38	S on 160		140	61 15 63	S on 174		North	24	S	
5 1300	Along Cross Result											
5 1900	Along Cross Result											

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
6 0100-Along Cross Result										
6 0700-Along Cross Result	18 14 23	N off 17	140	18 9 20	N off 7	South	23	S		
6 1300-Along Cross Result										
6 1900-Along Cross Result										
7 0100-Along Cross Result										
7 0700-Along Cross Result	20 10 23	N on 313	140	29 4 29	N off 349	no observation				
7 1300-Along Cross Result										
7 1900-Along Cross Result										
8 0100-Along Cross Result										
8 0700-Along Cross Result	12 0 12	S 160	140	4 11 12	N off 52	South	10	S		
8 1300-Along Cross Result										
8 1900-Along Cross Result										
9 0100-Along Cross Result										
9 0700-Along Cross Result	41 0 41	S 160	140	41 10 42	S on 174	North	28	S		
9 1300-Along Cross Result										
9 1900-Along Cross Result										
10 0100-Along Cross Result										
10 0700-Along Cross Result	10 8 13	N off 17	152	18 0 18	N 340	South	10	N		
10 1300-Along Cross Result										
10 1900-Along Cross Result										

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1990

Alongshore Cross-shore Resultant ---- Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)		Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
Day	Speed	Dir									
11 0100-Along Cross Result											
11 0700-Along Cross Result	20 10 22	S on 187		152	21 13 25	S on 191		North	11	S	
11 1300-Along Cross Result											
11 1900-Along Cross Result											
12 0100-Along Cross Result											
12 0700-Along Cross Result	11 0 11	S on 160		165	23 17 28	N on 303		North	20	S	
12 1300-Along Cross Result											
12 1900-Along Cross Result											
13 0100-Along Cross Result											
13 0700-Along Cross Result	13 0 13	S on 160		140	68 0 68	N on 340		South	25	N	
13 1300-Along Cross Result											
13 1900-Along Cross Result											
14 0100-Along Cross Result											
14 0700-Along Cross Result	1 0 1	S on 160		140	61 0 61	N on 340		South	41	N	
14 1300-Along Cross Result											
14 1900-Along Cross Result											
15 0100-Along Cross Result											
15 0700-Along Cross Result	0 10 10			140	61 6 61	N off 346		South	6	N	
15 1300-Along Cross Result											
15 1900-Along Cross Result											

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
16 0100-Along Cross Result											
16 0700-Along Cross Result	6 1 6	S off 151			128	61 18 64	N off 357		North	6 S	
16 1300-Along Cross Result											
16 1900-Along Cross Result											
17 0100-Along Cross Result											
17 0700-Along Cross Result	55 14 57	S off 146			140	61 15 63	S on 174		North	91 S	
17 1300-Along Cross Result											
17 1900-Along Cross Result											
18 0100-Along Cross Result											
18 0700-Along Cross Result	38 0 38	S off 160			140	76 0 76	S off 160		North	75 S	
18 1300-Along Cross Result											
18 1900-Along Cross Result											
19 0100-Along Cross Result											
19 0700-Along Cross Result	3 0 3	S off 160			152	4 2 4	N off 7		South	3 S	
19 1300-Along Cross Result											
19 1900-Along Cross Result											
20 0100-Along Cross Result											
20 0700-Along Cross Result	0 7 7				128	7 5 9	S off 123		North	12 S	
20 1300-Along Cross Result											
20 1900-Along Cross Result											

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1990

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)		Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
Day	Speed	Dir									
21 0100-Along Cross Result											
21 0700-Along Cross Result	8 0	S off		140	7 0	S off		North	15	S	
21 1300-Along Cross Result	8 160				7 160						
21 1900-Along Cross Result											
22 0100-Along Cross Result											
22 0700-Along Cross Result	27 8 28	N off 357		128	68 20 71	N off 357		South	30	N	
22 1300-Along Cross Result											
22 1900-Along Cross Result											
23 0100-Along Cross Result											
23 0700-Along Cross Result	15 0 15	S off 160		128	21 5 22	N off 354		no observation			
23 1300-Along Cross Result											
23 1900-Along Cross Result											
24 0100-Along Cross Result											
24 0700-Along Cross Result	32 0 32	S off 160		140	87 0 87	S off 160		no observation			
24 1300-Along Cross Result											
24 1900-Along Cross Result											
25 0100-Along Cross Result											
25 0700-Along Cross Result	4 3 5	N off 17		140	47 23 52	N off 7		South	16	N	
25 1300-Along Cross Result											
25 1900-Along Cross Result											

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Concluded)
Sep 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
26 0100-Along Cross Result										
26 0700-Along Cross Result	15 4 off	N	140	76 0	N	51	N			
26 1300-Along Cross Result	16 354			76 340		North				
26 1900-Along Cross Result										
27 0100-Along Cross Result										
27 0700-Along Cross Result	30 15 off	S	152	51 8 off	S	no observation				
27 1300-Along Cross Result	34 133			51 151						
27 1900-Along Cross Result										
28 0100-Along Cross Result										
28 0700-Along Cross Result	24 12 on	S	152	28 42	S	no observation				
28 1300-Along Cross Result	27 187			50 216						
28 1900-Along Cross Result										
29 0100-Along Cross Result										
29 0700-Along Cross Result	23 23 on	S	140	76 19	N	15	N			
29 1300-Along Cross Result	32 205			79 354		South				
29 1900-Along Cross Result										
30 0100-Along Cross Result										
30 0700-Along Cross Result	3 0 3	N	152	87 44 off	N	62	N			
30 1300-Along Cross Result	340			97 7		North				
30 1900-Along Cross Result										

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Sep 1990

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone.m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	1015	85	55	inoperative	110	26.7	1.0158	3.7
2	0930	85	45	inoperative	64	26.7	1.0158	4.0
3	0856	95		inoperative	55	26.7	1.0201	3.0
4	0740	95	35	inoperative	142	25.9	1.0201	2.1
5	0750	60	95	inoperative	79	25.6	1.0174	3.0
6	0913	95		inoperative	62	26.1	1.0187	2.7
7	0657	85	125	inoperative	30	26.4	1.0212	1.8
8	0610	85	25	inoperative	37	25.0	1.0214	1.8
9	1030	55	90	inoperative	82	26.1	1.0197	2.1
10	0513	95	50	inoperative	82	26.1	1.0190	3.0
11	0700	80	50	inoperative	91	26.7	1.0200	4.6
12	0815	90		inoperative	85	26.4	1.0192	4.3
13	0750	95		inoperative	82	26.1	1.0183	3.0
14	0731	95		inoperative	79	26.1	1.0180	3.0
15	0715	90		inoperative	49	26.1	1.0206	1.5
16	0738	70		inoperative	27	26.1	1.0210	2.4
17	0744	30		inoperative	76	25.3	1.0210	1.5
18	0806	30		inoperative	81	24.4	1.0200	1.8
19	0811	60		inoperative	24	24.2	1.0203	3.4
20	0805	75		inoperative	9	24.4	1.0207	2.4
21	0810	50		inoperative	12	24.2	1.0205	1.5
22	0917	100	80	inoperative	40	24.4	1.0209	1.2
23	0803	90	20	inoperative	46	25.0	1.0206	2.4
24	0700	30		inoperative	79	23.3	1.0212	1.2
25	0701	75	60	inoperative	46	22.8	1.0210	3.0
26	0640	95		inoperative	49	23.1	1.0210	3.4
27	0620	65	30	inoperative	49	24.4	1.0212	2.1
28	0655	40		inoperative	82	23.3	1.0214	1.8
29	0827	90		inoperative	67	22.8	1.0201	3.4
30	0753	90		inoperative	79	22.8	1.0194	3.4

PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Sep 1990

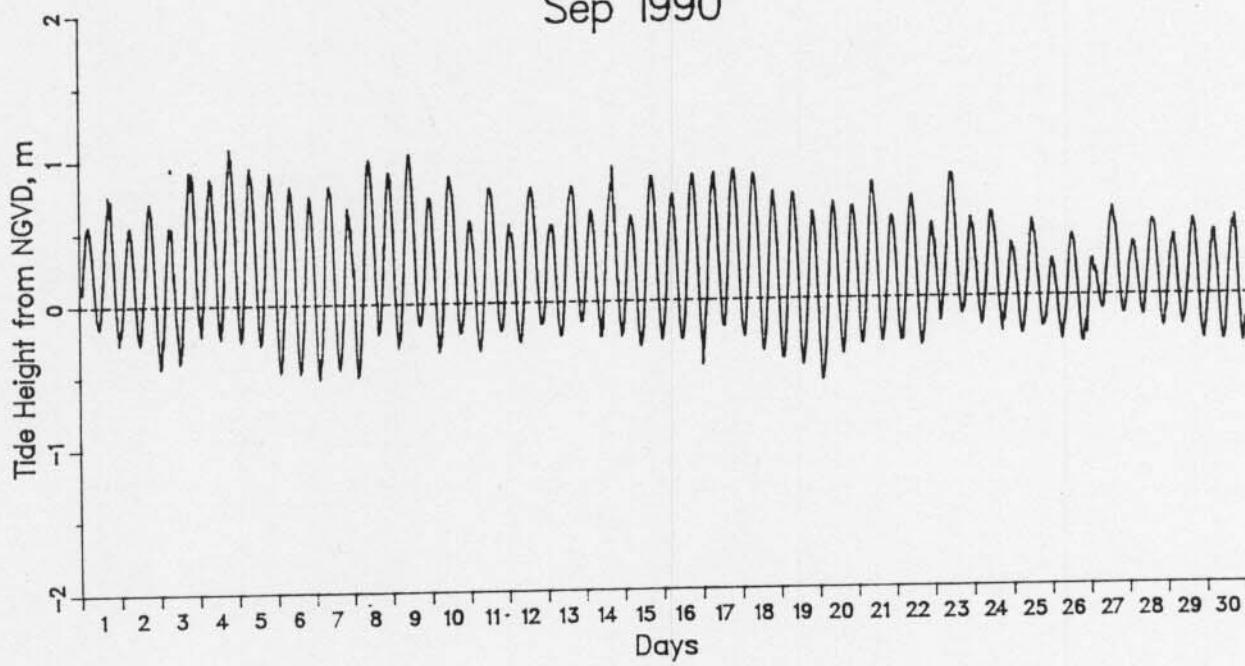


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low = -0.57 on day 20 at 124 EST
Extreme High = 1.08 on day 4 at 1830 EST
Monthly Mean = 0.20
Mean Low = -0.30
Mean High = 0.69
Mean Range = 0.98

Table 6: Water Levels.m NGVD

		Sep 1990			
Day	Mid-Cycle Time	Low	High	Mean	Range
1	612	-0.15	0.56	0.22	0.71
1	1837	-0.27	0.77	0.25	1.03
2	703	-0.27	0.55	0.14	0.82
2	1928	-0.44	0.71	0.15	1.15
3	753	-0.40	0.54	0.08	0.94
3	2018	-0.22	0.92	0.37	1.14
4	843	-0.23	0.88	0.34	1.11
4	2109	-0.25	1.08	0.40	1.33
5	934	-0.28	0.95	0.34	1.23
5	2159	-0.48	0.91	0.23	1.39
6	1024	-0.48	0.82	0.17	1.30
6	2249	-0.52	0.75	0.11	1.27
7	1115	-0.46	0.82	0.19	1.28
7	2340	-0.51	0.66	0.09	1.18
8	1205	-0.21	1.00	0.39	1.21
9	30	-0.31	0.91	0.31	1.22
9	1255	-0.15	1.03	0.41	1.18
10	121	-0.34	0.73	0.21	1.07
10	1346	-0.21	0.88	0.33	1.09
11	211	-0.34	0.57	0.13	0.91
11	1436	-0.20	0.80	0.30	0.99
12	301	-0.28	0.54	0.13	0.82
12	1527	-0.16	0.80	0.33	0.95
13	352	-0.24	0.53	0.16	0.77
13	1617	-0.14	0.80	0.34	0.94
14	442	-0.25	0.63	0.21	0.88
14	1707	-0.25	0.93	0.33	1.18
15	532	-0.32	0.59	0.14	0.91
15	1758	-0.27	0.86	0.31	1.13
16	623	-0.27	0.73	0.21	1.01
16	1848	-0.45	0.87	0.28	1.32
17	713	-0.19	0.88	0.32	1.06
17	1938	-0.26	0.90	0.33	1.16
18	804	-0.36	0.87	0.27	1.23
18	2029	-0.42	0.74	0.16	1.16
19	854	-0.46	0.73	0.14	1.19
19	2119	-0.57	0.60	0.02	1.17
20	944	-0.39	0.66	0.12	1.05
20	2210	-0.32	0.64	0.15	0.96
21	1035	-0.31	0.80	0.25	1.11
21	2300	-0.30	0.56	0.12	0.87
22	1125	-0.34	0.70	0.19	1.04
22	2350	-0.17	0.51	0.16	0.68
23	1216	-0.12	0.85	0.35	0.97
24	41	-0.20	0.55	0.16	0.74
24	1306	-0.25	0.59	0.19	0.84
25	131	-0.27	0.37	0.05	0.64
25	1356	-0.22	0.53	0.14	0.75
26	222	-0.31	0.25	-0.03	0.56
26	1447	-0.33	0.42	0.06	0.75
27	312	-0.27	0.25	0.05	0.52
27	1537	-0.13	0.61	0.25	0.74
28	402	-0.15	0.37	0.12	0.51
28	1628	-0.23	0.52	0.17	0.75
29	453	-0.22	0.41	0.09	0.63
29	1718	-0.31	0.52	0.12	0.84
30	543	-0.32	0.45	0.06	0.77
30	1808	-0.34	0.55	0.13	0.88

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in August and the only survey in September on profile line 188, located 517 m south of the pier. The most significant change was the development of a prominent berm high on the beach face (80 m). In addition the sharply defined nearshore bar (120 - 200 m) migrated 20 meters seaward.

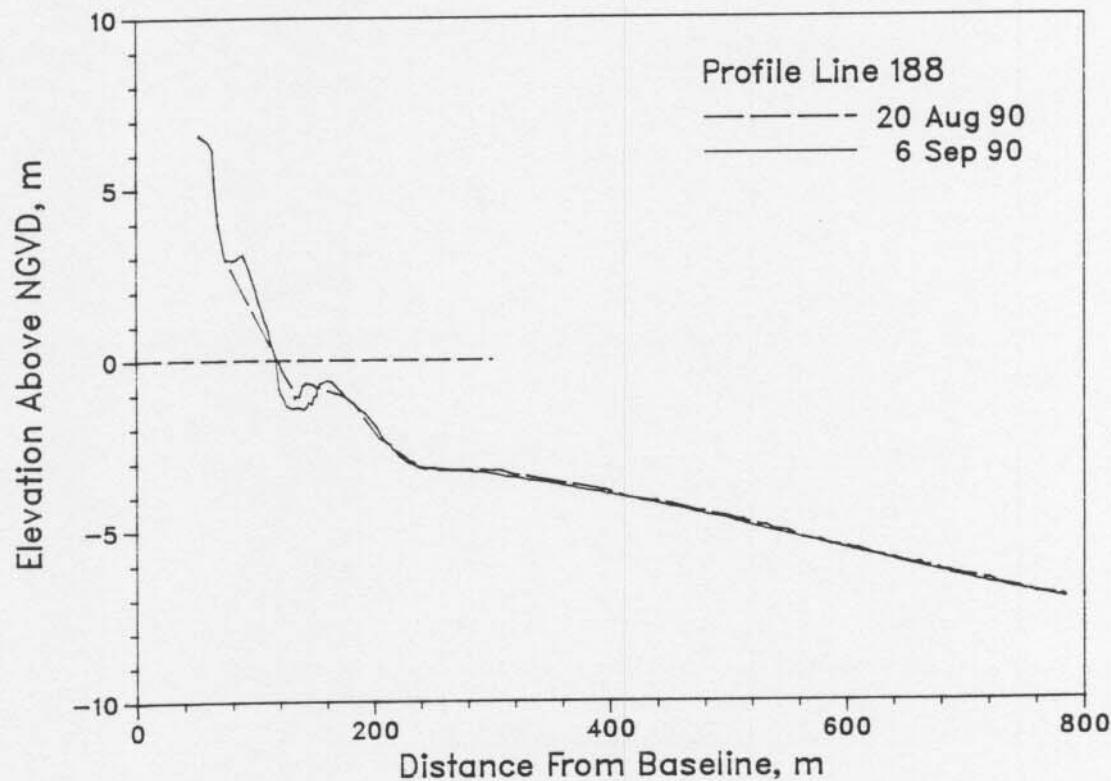


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1990. The development of the berm and the movement of the nearshore bar are responsible for the two changes (80 and 160 m) visible on the envelope.

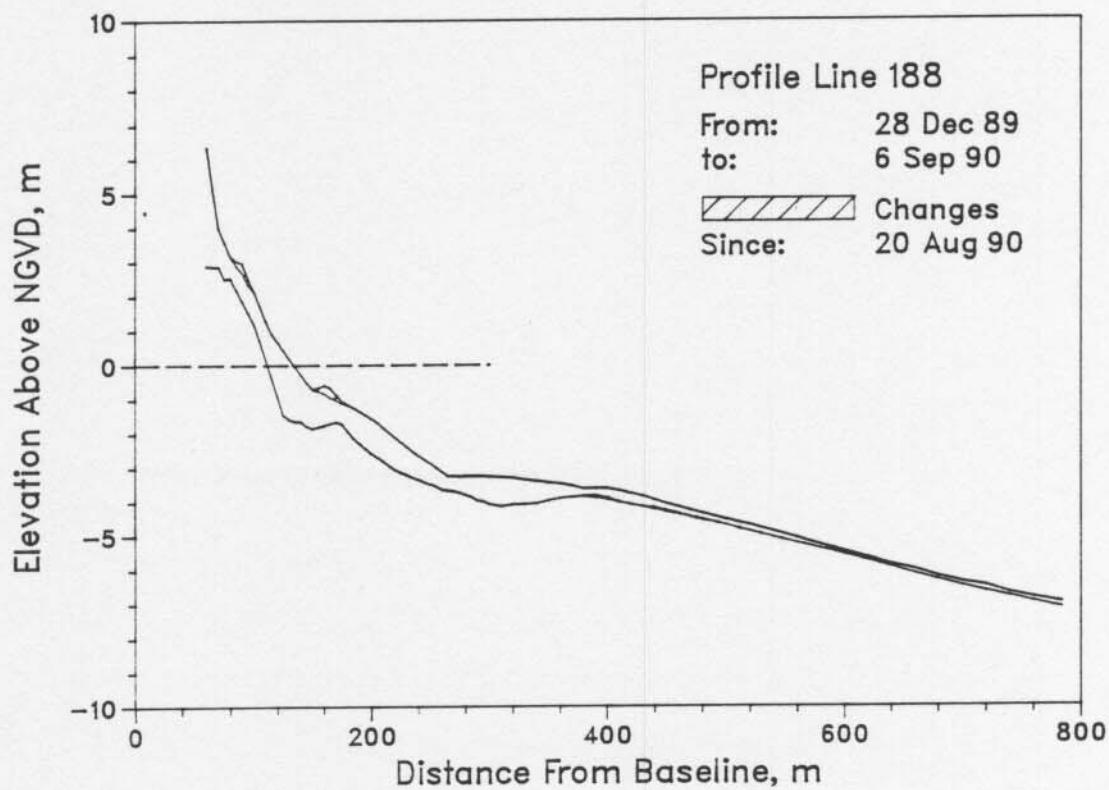


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 6 September. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

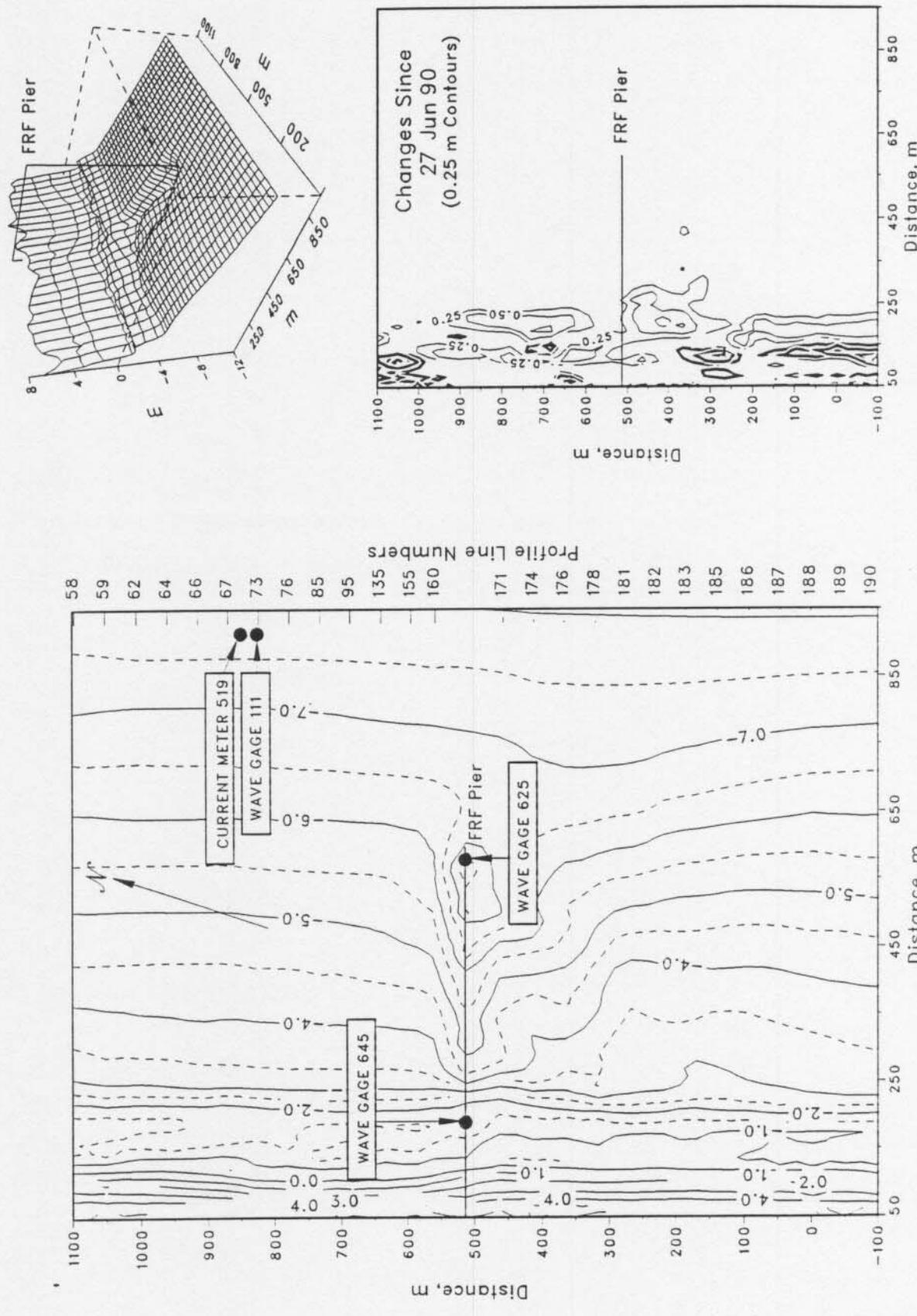


Figure 8. FRF bathymetry 6 Sep 90 depths relative to NGVD

Distribution List

Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

Colleges/Universities:

California Inst. of Tech.	Stockton State College
East Carolina University	University of Akron
Florida Inst. of Tech.	University of Delaware
Harvard University	University of Florida
Naval Post Graduate School	University of Maryland
NC State University	University of Miami
Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Mr. Mason	WCTI-TV
Masonite Corporation	SEASUN Power Systems

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)
Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)